CLAIMS

1. A method for controlling and stabilizing heat-transfer conditions between a source of heat and a heat-receiving object in a range of working temperatures, said method comprising the steps of:

providing a heat-transfer interface device, which is in heat-transfer engagement with said source of heat and said heat-receiving object, between said source of heat and said heat-receiving object, said heat-transfer interface device comprising an elastomeric material filled with an electrically-nonconductive and thermally-conductive filler, said heat-transfer interface device having a space that can be filled with said elastomeric material during redistribution thereof in said heat-transfer interface device under the effect of variations in said working temperature, said heat-transfer interface device having one side facing said source of heat and another side facing said heat-receiving object;

compressing said heat-transfer interface device with a compression force that displaces said elastomeric material into said space, said compression force having a magnitude that maintains said heat-transfer interface device in a compressed state and maintains said heat-transfer engagement at variations of said working temperatures.

2. The method of Claim 1, wherein said heat-transfer interface device normally operates at working temperatures up to 320°C.

3. The method of Claim 1, wherein said heat-transfer interface device having a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

4. The method of Claim 2, wherein said heat-transfer interface device having a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

5. The method of Claim 3, wherein said space inside said elastomeric material are recesses formed in surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by curvatures on said surface.

6. The method of Claim 4, wherein said space inside said elastomeric material are recesses formed in surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by curvatures on said surface.

7. The method of Claim 5, wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface and one of said source of heat and said heat-receiving object is a convex surface.

8. The method of Claim 6, wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface and one of said source of heat and said heat-receiving object is a convex surface.

9. The method of Claim 5, wherein said heat-transfer interface device has a substantially circular shape, and wherein said recesses are arranged in radial rows.

10. The method of Claim 6, wherein said heat-transfer interface device has a substantially circular shape, and wherein said recesses are arranged in radial rows.

11. The method of Claim 1, wherein said elastomeric material comprises perfluoroelastomer polymer.

12. The method of Claim 2, wherein said elastomeric material comprises perfluoroelastomer polymer.

13. The method of Claim 4, wherein said elastomeric material comprises perfluoroelastomer polymer.

14. The method of Claim 11, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, beryllium oxide, and carbon.

15. The method of Claim 14, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

16. The method of Claim 15, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

17. The method of Claim 13, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, beryllium oxide, and carbon.

18. The method of Claim 17, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

19. The method of Claim 18, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

20. The method of Claim 1, further comprising a step of reinforcing said heat-transfer interface device by placing a reinforcing member into said elastomeric material.

21. The method of Claim 2, further comprising a step of reinforcing said heat-transfer interface device by placing a reinforcing member into said elastomeric material.

22. The method of Claim 5, further comprising a step of reinforcing said heat-transfer interface device by placing a reinforcing member into said elastomeric material.

23. The method of Claim 8, further comprising a step of reinforcing said heat-transfer interface device by placing a reinforcing member into said elastomeric material.

24. The method of Claim 1, further comprising the step of using said heat-transfer interface device in a processing apparatus having a hollow coil located in said elastomeric material, said heat-receiving object comprising a cooling medium flowing though said hollow coil.

25. The method of Claim 24, wherein said heat-transfer interface device normally operates at working temperatures up to 320°C.

26. The method of Claim 25, wherein said hollow coil is an electrically heated coil.

27. The method of Claim 24, wherein said processing apparatus is an inductive coupling plasma reactor and wherein said hollow coil is an RF coil.

28. The method of Claim 27, wherein said heat-transfer interface device has a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

29. The method of Claim 26, wherein said heat-transfer interface device has a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

30. The method of Claim 28, wherein said space inside said elastomeric material are recesses formed in the surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by curvatures on said surface.

31. The method of Claim 29, wherein said space inside said elastomeric material are recesses formed in the surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by curvatures on said surface.

32. The method of Claim 30, wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface

and one of said source of heat and said heat-receiving object is formed by a convex surface.

33. The method of Claim 31, wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface and one of said source of heat and said heat-receiving object is formed by a convex surface.

34. The method of Claim 32, wherein said elastomeric material is selected from the group consisting of perfluoroelastomer-type elastomeric perfluoropolymers, high-temperature-resistant silicone elastomers, and poly(phospho)zene elastomers.

35. The method of Claim 34, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, and beryllium oxide.

36. The method of Claim 35, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

37. The method of Claim 33, wherein said elastomeric material is selected from the group consisting of perfluoroelastomer-type elastomeric perfluoropolymers, high-temperature-resistant silicone elastomers, and poly(phospho)zene elastomers.

38. The method of Claim 37, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, and beryllium oxide.

39. The method of Claim 38, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

40. A heat-transfer interface device for use in a range of working temperatures comprising:

a source of heat;

a heat-receiving object;

an elastomeric material filled with an electrically-nonconductive and thermally-conductive filler material, said elastomeric material being located between said source of heat and said heat-receiving object in a heat-transfer engagement therewith so that one side of said elastomeric material faces said source of heat and said another side faces said heat-receiving object;

said elastomeric material having recesses on the surface and being in a compressed state by compression between said source of heat and said heat-receiving object;

said elastomeric material having a space that can be filled with said elastomeric material during redistribution thereof in said heat-transfer interface device under the effect of variations in said working temperature;

said elastomeric material being compressed with a compression force that displaces said elastomeric material into said space, said compression force having a magnitude that maintains said heat-transfer interface device in a compressed state and maintains said heat-transfer engagement at variations of said working temperatures.

41. The device of Claim 40, wherein said working temperatures are up to 320°C.

42. The device of Claim 40, wherein said heat-transfer interface device has a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

43. The device of Claim 41, wherein said heat-transfer interface device has a surface and wherein said space is selected from the group consisting of a space inside said elastomeric material and a space formed between said surface and one of said source of heat and said heat-receiving object.

44. The device of Claim 42, wherein said space inside said elastomeric material are recesses formed in the surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by curvatures on said surface.

45. The device of Claim 43, wherein said space inside said elastomeric material are recesses formed in the surface of said elastomeric material, and wherein said space formed between said heat-transfer interface device and one of said source of heat and said heat-receiving object is provided by a curvature on said surface.

46. The device of Claim 44, wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface and one of said source of heat and said heat-receiving object is formed by a convex surface.

47. The device of Claim 45 wherein said heat-transfer interface device has a substantially circular shape and wherein said space formed between said surface and one of said source of heat and said heat-receiving object is formed by a convex surface.

48. The device of Claim 46, wherein said heat-transfer interface device has a substantially circular shape and wherein said recesses are arranged in radial rows.

49. The device of Claim 47, wherein said heat-transfer interface device has a substantially circular shape and wherein said recesses are arranged in radial rows.

50. The device of Claim 40, wherein said elastomeric material comprises perfluoroelastomer polymer.

51. The device of Claim 41, wherein said elastomeric material comprises perfluoroelastomer polymer.

52. The device of Claim 50, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, beryllium oxide, and carbon.

53. The device of Claim 51, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, beryllium oxide, and carbon.

54. The device of Claim 52, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

55. The device of Claim 54, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

56. The device of Claim 53, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

57. The device of Claim 56, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

58. The device of Claim 48, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

59. The device of Claim 58, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

60. The device of Claim 59, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

61. The device of Claim 49, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

62. The device of Claim 61, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

63. The device of Claim 62, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.

64. The device of Claim 40, further comprising a reinforcing member in said elastomeric material.

65. The device of Claim 41, further comprising a reinforcing member in said elastomeric material.

66. The device of Claim 52, further comprising a reinforcing member in said elastomeric material.

67. The device of Claim 57, further comprising a reinforcing member in said elastomeric material.

68. The device of Claim 53, further comprising a reinforcing member in said elastomeric material.

69. The device of Claim 41, further provided with a hollow coil located in said elastomeric material, said heat-receiving object comprising a cooling medium flowing though said hollow coil.

70. The device of Claim 69, wherein said hollow coil is an electrically heated coil.

71. The device of Claim 70, which is a heat-transfer interface device located in an inductive coupling plasma reactor having a plasma generation chamber, said plasma generation chamber comprising said source of heat.

72. The device of Claim 71, wherein said elastomeric material comprises perfluoroelastomer polymer.

73. The device of Claim 72, wherein said filler material is selected from the group consisting of boron nitride, aluminum nitride, beryllium oxide, and carbon.

74. The device of Claim 73, wherein said filler material further comprises a combined mixing-assisting and compression-set reducing agent.

75. The device of Claim 74, wherein said combined mixing-assisting and compression-set reducing agent is perfluoropolyether.